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TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application No.	10/791,030
Filing Date	March 1, 2004
First Named Inventor	Xinye Liu
Art Unit	1763
Examiner Name	Unassigned
Total Number of Pages in This Submission: 14	Attorney Docket Number: 4551P011

ENCLOSURES ***(check all that apply)***

- ☒ Fee Transmittal Form
  - ☒ Fee Attached
- ☒ Amendment / Response
  - ☐ After Final
  - ☐ Affidavits/declaration(s)
- ☐ Extension of Time Request
- ☐ Express Abandonment Request
- ☐ Information Disclosure Statement
  - ☐ PTO/SB/08
- ☐ Certified Copy of Priority Document(s)
- ☐ Response to Missing Parts/ Incomplete Application
  - ☐ Basic Filing Fee
  - ☐ Declaration/POA
  - ☐ Response to Missing Parts under 37 CFR 1.52 or 1.53
- ☐ Drawing(s)
- ☐ Licensing-related Papers
- ☐ Petition
- ☐ Petition to Convert a Provisional Application
- ☐ Power of Attorney, Revocation Change of Correspondence Address
- ☐ Terminal Disclaimer
- ☐ Request for Refund
- ☐ CD, Number of CD(s)
- ☐ After Allowance Communication to Group
- ☐ Appeal Communication to Board of Appeals and Interferences
- ☐ Appeal Communication to Group **(Appeal Notice, Brief, Reply Brief)**
- ☐ Proprietary Information
- ☐ Status Letter
- ☒ Other Enclosure(s) *(please identify below):*

Petition to Make Special (CFR 1.102(d)); Postcard.

Remarks

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm or Individual name	Tarek N. Fahmi, Reg. No. 41,402 BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP
Signature	
Date	February 25, 2005

CERTIFICATE OF MAILING/TRANSMISSION

I hereby certify that this correspondence is being deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to: Mail Stop Petition, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Typed or printed name	Geneva Walls		
Signature	Geneva Walls	Date	February 25, 2005

Based on PTO/SB/21 (04-04) as modified by Blakely, Sokoloff, Taylor & Zafman (wlr) 06/04/2004.
SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

Attorney's Docket No.: 4551P011 Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Confirmation No.: 1253

Application No.: 10/791,030

First Named Inventor: Xinye Liu

Filed: March 1, 2004

Art Unit: 1763

Examiner: Fuller, Eric B.

Docket No.: 4551P011

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On February 25, 2005
Date of Deposit

Geneva Walls
Name of Person Mailing Correspondence

Signature February 25, 2005
Date

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

PRELIMINARY AMENDMENT AND
PETITION TO MAKE SPECIAL (37 CFR 1.102(d))

Sir:

Upon entry of the amendments set forth below, applicants hereby petition to make this new application special. This application has not received any examination on the merits.

Amendments to the claims begin on page 2 of this paper.

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of the claims in the application:

Claims 1-25 (Cancelled).

26. (Currently Amended) A method, comprising performing an expose period of an atomic layer deposition (ALD) process using a first ~~purge~~ flow ~~at~~ set with a first upstream manifold pressure, the first ~~purge~~ flow passing through (i) a first flow limiting conductance located within a first gas flow pathway upstream of a reactor chamber within which the ALD process is performed, and (ii) a second flow limiting conductance located within a ~~second~~ gas flow pathway downstream of the reactor chamber, and performing a reactant removal purge period of the ALD process using a ~~second~~ purge flow ~~at~~ set with a second upstream manifold pressure ~~greater than the first pressure~~, the ~~second~~ purge flow passing through (i) a third flow limiting conductance located within ~~the first~~ a second gas flow pathway upstream of the reactor, and (ii) a fourth flow limiting conductance located in the ~~second~~ gas flow pathway downstream of the reactor, wherein a ratio of the first flow limiting conductance to the second flow limiting conductance is nominally equal to a ratio of the third flow limiting conductance to the fourth flow limiting conductance and a pressure of the reactor chamber is maintained nominally constant during the ALD process.

27. (Currently Amended) The method of claim 26, wherein a ~~second purge~~ first gas used for the ~~second purge~~ first flow is different from a ~~first purge~~ second gas used for the ~~first~~ purge flow.

28. (Original) The method of claim 26, wherein the expose period comprises a plasma-assisted process.

29. (Currently Amended) The method of claim 26, wherein the first ~~purge~~ flow is switched to the ~~second~~ purge flow at a substantially coincident point in time as the first flow limiting conductance within the first gas flow pathway upstream of the reactor is switched to the third flow limiting conductance within the second gas flow pathway upstream of the reactor.

30. (Currently Amended) The method of claim 26, wherein the first ~~purge~~ flow is switched to the ~~second~~ purge flow prior to completion of material deposition during the expose period.

31. (Currently Amended) The method of claim 26, wherein the first ~~purge~~ flow is switched to the ~~second~~ purge flow at a different point in time than that at which the second flow limiting conductance in the ~~second~~ gas flow pathway downstream of the reactor is switched to the fourth flow limiting conductance.

Claims 32 – 55 (Cancelled).

56. (New) An atomic layer deposition (ALD) apparatus, comprising

a first gas flow pathway coupled upstream of a reaction chamber and having switchable first and third flow limiting conductances such that during an expose period of an ALD process the first gas flow pathway is operable to provide a first flow from a first pressure source to the reaction chamber and during a reactant removal purge period of the ALD process the first gas flow pathway is operable to provide a second flow from a second pressure source to the reaction chamber, the second pressure source having a greater pressure than the first pressure source; and

a second gas flow pathway coupled downstream of the reaction chamber and having switchable second and fourth flow limiting conductances, a ratio of the first flow limiting conductance to the second flow limiting conductance being nominally equal to a ratio of the third flow limiting conductance to the fourth flow limiting conductance, configured such that during the ALD process a nominally constant pressure in the reaction chamber can be maintained.

57. (New) The ALD apparatus of claim 56, wherein the first gas flow pathway is configured to provide a first gas for the first flow different from a second gas for the second flow.

58. (New) The ALD apparatus of claim 56, wherein the expose period comprises a plasma-assisted process.

59. (New) The ALD apparatus of claim 56, wherein the first gas flow pathway is configured such that the first flow limiting conductance is switched to the third flow limiting conductance at a substantially coincident point in time as the first flow is switched to the second flow.

60. (New) The ALD apparatus of claim 56, wherein the first gas flow pathway is configured so that the first flow is switchable to the second flow prior to completion of material deposition during the expose period.

61. (New) The ALD apparatus of claim 56, wherein the second gas flow pathway is configured such that the second flow limiting conductance in the second gas flow pathway is switchable to the fourth flow limiting conductance at a different point in time than that at which the first flow is switched to the second flow.

62. (New) An atomic layer deposition (ALD) system, comprising:

a gas flow pathway coupled upstream of a reactor chamber through selectable upstream flow limiting conductances having two or more operational modes including a low flow mode and a high flow mode; and

a pumping arrangement coupled downstream of the reactor chamber through selectable downstream flow limiting conductances having two or more operational modes including a low flow mode and a high flow mode,

wherein the upstream flow limiting conductances and downstream flow limiting conductances are configured to switch operational modes in time-phase with one another.

63. (New) The ALD apparatus of claim 62, wherein the upstream flow limiting conductances are configured to switch operational modes prior to the downstream flow limiting conductances switching operational modes.

64. (New) The ALD apparatus of claim 62, wherein the downstream flow limiting conductances include a throttle valve.

65. (New) The ALD apparatus of claim 64, wherein the throttle valve comprises an annular throttle valve located within the reactor chamber.

66. (New) The ALD apparatus of claim 65, wherein the annular throttle valve includes multiple vanes, each having an axis therethrough.

67. (New) The ALD apparatus of claim 65, wherein the annular throttle valve includes includes multiple blades arranged in an iris configuration.

68. (New) The ALD apparatus of claim 65, wherein the annular throttle valve includes multiple blades, each having a number of holes therethrough, at least one of the blades being rotatable about an axis such that holes extending through the rotatable blade align with holes of at least one of the other blades to provide a passage through the annular throttle valve.

69. (New) The ALD apparatus of claim 62, wherein the gas flow pathway comprises multiple gas flow pathways for purge gasses and chemical precursors which share one or more common inputs to the reactor chamber.

70. (New) The ALD apparatus of claim 62, wherein the upstream flow limiting conductances and downstream flow limiting conductances are configured to switch operations modes according to a difference in residence times for passage of gas between (i) the upstream conductances and the reaction chamber, and (ii) the reaction chamber and the downstream conductances.

71. (New) The method of claim 26, wherein the first upstream manifold pressure and the second upstream manifold pressure are the same.

72. (New) The method of claim 26, wherein the second upstream manifold pressure is greater than the first upstream manifold pressure.

73. (New) The method of claim 26, wherein the first gas flow pathway upstream of the reactor and the second gas flow pathway upstream of the reactor comprise a common gas flow pathway.

74. (New) The method of claim 29, wherein the first gas flow pathway upstream of the reactor and the second gas flow pathway upstream of the reactor comprise a common gas flow pathway.

PETITION TO MAKE SPECIAL

(A) FEE

Applicants hereby enclose a check in the amount of $130.00 for the petition fee required by 37 C.F.R. § 1.17(h). Furthermore, the Commissioner is hereby authorized to charge payment of any fee due under 37 C.F.R. § 1.16 and § 1.17 associated with this communication or any future communication in this or any related application filed pursuant to 37 C.F.R. § 1.53 or credit any overpayment to Deposit Account No. 02-2666.

(B) CLAIMS

Either (1) all pending claims in this application are directed to a single invention, or (2) if the Office determines that all the claims are not obviously directed to a single invention, applicants will make an election without traverse in response to notification under the established telephone restriction practice.

(C) SEARCH

A search for relevant prior art was made in a counterpart application filed under the Patent Cooperation Treaty, International Application No. PCT/US04/006342. The results of that search were reported in the International Search Report dated November 18, 2004 and commented upon in the Written Opinion of the International Search Authority of the same date. A copy of the Search Report, the Written Opinion and the references cited by both was provided in a Information Disclosure Statement filed January 10, 2005. The references cited were:

a. Chiang, Tony P. et al., US 2002/0076508;
b. Kim, Yeong-Kwan et al., US 2003/0013320; and
c. Lindfors, Sven et al., US 2001/0054377.

(D) COPIES OF REFERENCES

Additional copies of references located during the above-referenced search that are deemed most closely related to the subject matter encompassed by the claims are enclosed

herewith for the Examiner's convenience.

The submission of these references is for the purpose of providing a complete record and is not a concession that the references listed therein are prior art to the invention claimed in the patent application. The right is expressly reserved to establish an invention date earlier than the above-identified filing date in order to remove any reference submitted herewith as prior art should it be deemed appropriate to do so.

Further, the submission of the references is not to be taken as a concession that any reference represents art that is relevant or analogous to the claimed invention. Accordingly, the right to argue that any reference is not properly within the scope of prior art relevant to an examination of the claims in the above-identified application is also expressly reserved.

(E) DETAILED DISCUSSION OF THE REFERENCES

A detailed discussion of the references deemed most closely related to the subject matter encompassed by the claims is provided below. It should be noted that the Written Opinion of the International Search Authority established the patentability of claims 26 – 31 (prior to the above amendments) over these references. For at least the reasons set forth below, none of the foregoing amendments should alter this conclusion. Moreover, none of the cited reference anticipates or obviates the invention recited in new claims 56 - 70.

1. <u>All of the Present Claims Find Support in the Specification as Originally Filed</u>

Claim 26 has been amended to clarify certain matters, but such amendments do not alter the scope of substance of the claim. In particular, the phrase "upstream manifold pressure" has been used to better indicate which pressure is being referred to. Likewise, the phrase "flow limiting conductance" is used consistently throughout the claims to avoid any ambiguities that might have been present. The phrase "purge period" was amended to "reactant removal purge period" to clarify the nature of this process. The phrase "first flow" is now used to avoid confusion regarding the flow during the expose period. This change made the previous reference to "first purge flow" and "second purge flow" irrelevant and so the unnecessary "first' and "second" descriptors have been removed. All of these amendments are supported in the specification as originally filed, for example at paragraphs 46 – 48, and no new matter is being added. Further, the claim has been clarified to indicate that the first flow and purge flow are "set with" first and second upstream manifold pressures, respectively, and these amendments find

support in paragraph 63 of the specification as originally filed.

Claims 27 – 31 have been amended to conform to the amendments made in claim 26, without altering the scope or substance of these claims. Hence these claims are necessarily supported by the specification as originally filed.

New claims 56 – 61 recite subject matter similar to that found in claims 26 – 31 and are therefore likewise supported by the specification as originally filed. See also paragraph 52 of the specification. No new matter is added by these claims.

New claims 62 – 70 find support at these and other portions of the specification as originally filed. See, for example, paragraphs 74 – 81 in addition to those cited above. Hence, no new matter is added by these claims.

New claim 71 finds support in the specification as originally filed, for example at paragraphs 63 and 64, which describe the use of a common pressure setting.

New claim 72 finds support in claim 26 as originally filed.

New claims 73 and 74 find support in the specification as originally filed, for example in Figs. 5 – 7 and the accompanying text.

2. All of the Present Claims are Patentable over the References Located During the International Search

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631 (Fed. Cir. 1987). In the present cases, none of the references cited by the International Search Authority teach each and every element of the present claims. Indeed, the Written Opinion of the International search Authority confirmed that claims 26 – 31 were patentable over these references. Claims 56 – 61 recite subject matter substantially similar to claims 26 – 31 and so should be deemed likewise patentable. Claim 62 recites selectable upstream and downstream flow limiting conductances each having two or more operational modes, which (as discussed in greater detail below) are not found in any of the teachings of the cited references. Hence, claim 62 and its dependent claims are patentable over these references.

a. Chiang, Tony P. et al., US 2002/076508

The Chiang reference describes an atomic layer deposition (ALD) system that controls the "gas flux" on a substrate in a reaction chamber by controlling the conductance between the reaction chamber and a lower pressure volume outside the reaction chamber (see Abstract). In

particular, it is the downstream conductance that is varied through vertical displacement of a vertically-translateable reaction chamber shield (14). A gap between a lower portion of the shield 14 and a stationary pedestal 4 defines an annular pumping channel from the reaction chamber such that when the shield is moved between upper and lower positions, the downstream conductance from the reaction chamber to the pump varies. See Chiang at p. 4, paragraphs 72 – 76. Note, it is important to recognize that although a gap 22 between the shield 14 and a chamber lid 10 is located near what is the physical top of the reaction chamber, from a gas flow perspective this is "downstream" from the reaction chamber because gas is evacuated from the chamber, through the gap, to a pump (see Chiang at p. 4, paragraph 75). Hence, Chang is concerned only with variations in downstream conductance from a reaction chamber.

Furthermore, the ALD process described by Chiang is specifically designed to operate using highly variable reactor pressures. As is illustrated in Chiang's Figures 37 and 38, an ALD process is carried out using variable downstream conductances which necessarily lead to variable reactor pressures. Nothing in Chang suggests that there is any attempt to control upstream conductances or maintain nominally constant reactor pressures over an entire ALD cycle.

In contrast, claims 26 and 56 each recite the use of upstream and downstream flow limiting conductances so as to maintain nominally constant reaction chamber pressures during the ALD cycle. These are significant differences between these claims and the ALD processing apparatus descried by Chiang ands so claims 26 and 56, and their respective dependent claims, are patentable over Chiang.

Claim 62 recites "selectable upstream flow limiting conductances having two or more operational modes". Such features are not found in the apparatus described by Chiang, which (as discussed above) describes only the use of downstream switchable flow limiting conductances. For at least this reason claim 62 and its dependent claims are patentable over Chiang.

Moreover, the particular configurations of annular throttle vales recited in claims 66 – 68 are not taught or suggested by Chiang. The lower gap 24 formed between the chamber shield 14 and the stationary pedestal 4 in Chiang's ALD processing apparatus forms what the International Search Authority considered to be an annular throttle valve. However, at best this is an annular throttle valve without any vanes or other controllable elements. In contrast, the features of the particular throttle vales recited in claims 66 – 68 include vanes (claim 66) or blades (claims 67 and 68), which distinguish these throttle valves over the configuration described by Chiang. These are separate reasons for the patentability of these claims over Chiang.

b. Kim, Yeong-Kwan et al., US 2003/13320

The Kim reference describes an ALD reactor which uses a "dilution step" during which an inert gas is supplied to the reaction chamber. The introduction of this inert gas causes the reaction chamber pressure to rise. According to the Written Opinion of the International Search Authority, the pressure rises because the pumping capacity during the time at which the inert gas is introduced to the chamber is low. Subsequently, when this pump capacity is increased, the reaction chamber pressure falls.

Whether or not the pump capacity is truly varied in the apparatus described by Kim, it should be readily apparent that there are may features of the present claims that are simply not found in or suggested by this reference. For example, Kim's ALD apparatus makes no provision for switchable/selectable upstream and downstream conductances as recited in the present claims. Furthermore, the Kim apparatus is operated such that the reaction chamber pressure is varied over the APD procedure. This is unlike the apparatus recited in claims 26 and 56, which is configured to maintain a nominally constant reaction chamber pressure over the ALD process. For at least these reasons, the present claims are patentable over Kim.

c. Lindfors, Sven et al., US 2001/054377

The Lindfors reference describes an ALD process in which pressure in the reaction chamber is kept nominally constant by injecting a neutral gas flow downstream of the reaction chamber (see paragraph 57). Importantly, Lindfors fails to teach or suggest the use of switchable / selectable upstream and downstream conductances as recited in the present claims. Instead, the only flow limiting conductances described by Lindfors appear to be static conductances (see, e.g., paragraph 42). Moreover, with respect to claims 26 and 56, Lindfors does not appear to provide for any variation in gas flow during an expose period and a wherewithal to provide for an enhanced reactant removal purge period as recited in these claims. That is, the purge flow appears to be matched to the carrier and source flows. For at least these reasons, the claims are patentable over Lindfors.

(F) SUMMARY

For at least the foregoing reasons, the claims are patentable over the references located during the above-referenced search that are deemed most closely related to the subject matter encompassed by the claims. If there are any additional fees associated with this communication, please charge our deposit account 02-2666.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP

Date: 2/25, 2005

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FEE TRANSMITTAL for FY 2005

Patent fees are subject to annual revision.

☒ Applicant claims small entity status. See 37 CFR 1.27.

TOTAL AMOUNT OF PAYMENT ($) 130.00

Complete if Known	
Application Number	10/791,030
Filing Date	March 1, 2004
First Named Inventor	Xinye Liu
Examiner Name	Unassigned
Art Unit	1763
Attorney Docket No.	4551P011

METHOD OF PAYMENT *(check all that apply)*

☒ Check ☐ Credit card ☐ Money Order ☐ None ☐ Other (please identify): _____

☒ Deposit Account Deposit Account Number: 02-2666 Deposit Account Name: Blakely, Sokoloff, Taylor & Zafman LLP

For the above-identified deposit account, the Director is hereby authorized to: (check all that apply)

☐ Charge fee(s) indicated below ☐ Charge fee(s) indicated below, except for the filing fee

☒ Charge any additional fee(s) or underpayment of fee(s) under 37 CFR §§ 1.16, 1.17, 1.18 and 1.20. ☒ Credit any overpayments

FEE CALCULATION

1. EXTRA CLAIM FEES

			Extra Claims		Fee from below		Fee Paid
Total Claims	34	- 55** =	0	X	25.00	=	$0.00
Independent Claims	3	- 1** =	0	X	100.00	=	$0.00
Multiple Dependent						=	

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
1202	50	2202	25	Claims in excess of 20
1201	200	2201	100	Independent claims in excess of 3
1203	360	2203	180	Multiple Dependent claim, if not paid
1204	300	2204	150	**Reissue independent claims over original patent
1205	300	2205	150	**Reissue claims in excess of 20 and over original patent

SUBTOTAL (1) ($) 0.00

***or number previously paid, if greater, For Reissues, see below*

2. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1051	130	2051	65	Surcharge - late filing fee or oath	
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet.	
2053	130	2053	130	Non-English specification	
1251	120	2251	60	Extension for reply within first month	
1252	450	2252	225	Extension for reply within second month	
1253	1,020	2253	510	Extension for reply within third month	
1254	1,590	2254	795	Extension for reply within fourth month	
1255	2,160	2255	1,080	Extension for reply within fifth month	
1401	500	2401	250	Notice of Appeal	
1402	500	2402	250	Filing a brief in support of an appeal	
1403	1,000	2403	500	Request for oral hearing	
1451	1,510	2451	1,510	Petition to institute a public use proceeding	
1460	130	2460	130	Petitions to the Commissioner	
1807	50	1807	50	Processing fee under 37 CFR 1.17(q)	
1806	180	1806	180	Submission of Information Disclosure Stmt	
1809	790	1809	395	Filing a submission after final rejection (37 CFR § 1.129(a))	
1810	790	2810	395	For each additional invention to be examined (37 CFR § 1.129(b))	
Other fee (specify)				Petition to Make Special (CFR 1.102(d))	130.00

SUBTOTAL (2) ($) 130.00

SUBMITTED BY Complete (if applicable)

Name (Print/Type)	Tarek N. Fahmi	Registration No. (Attorney/Agent)	41,402	Telephone	(408) 947-8200
Signature				Date	02/25/05

Based on PTO/SB/17 (12-04) as modified by Blakely, Sokoloff, Taylor & Zafman (wlr) 12/15/2004.
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